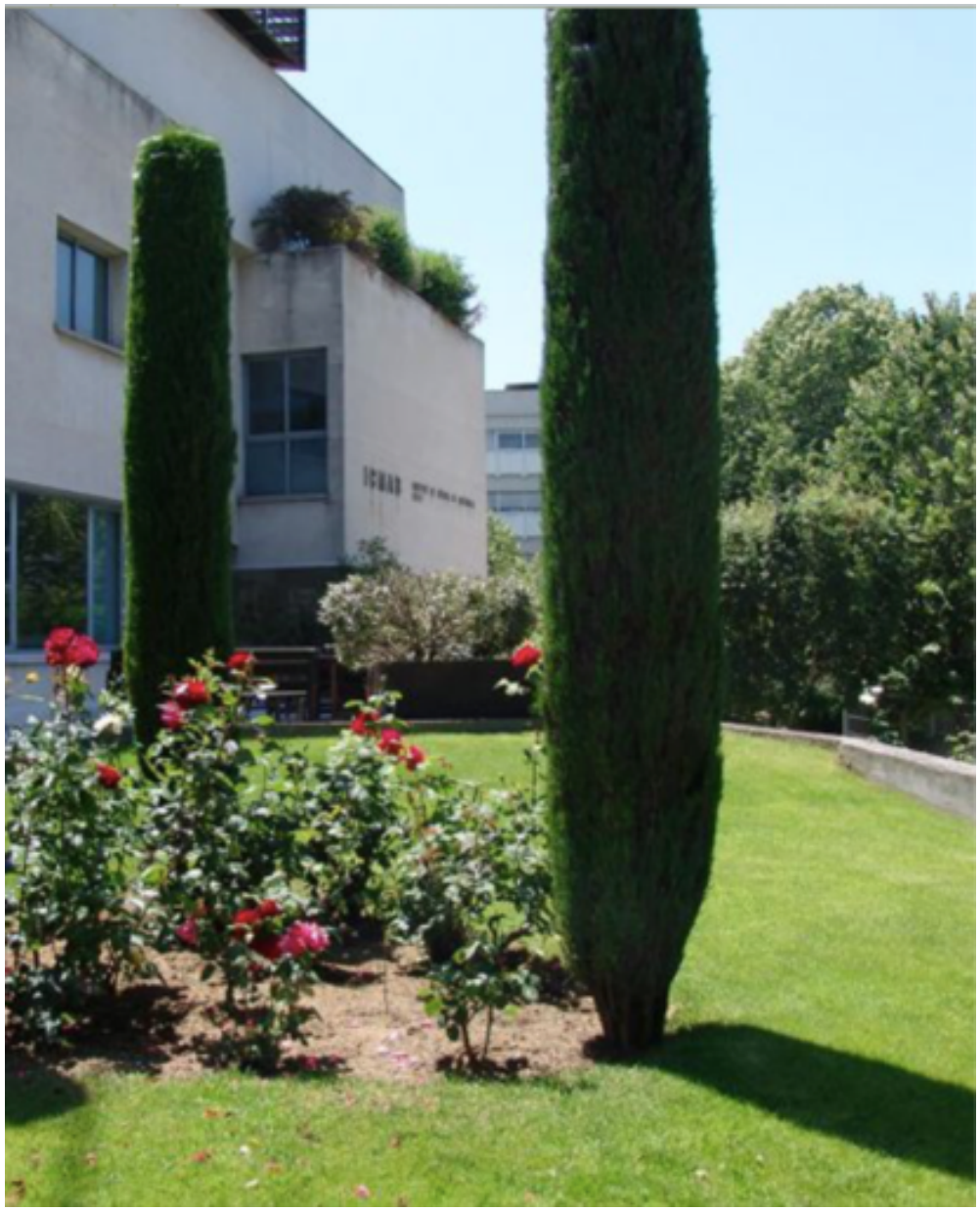

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rednanolito

ICMAB EXCELENCIA SEVERO OCHOA

CSIC
Consejo Superior de Investigaciones Científicas

Scientific and Technical Services at ICMAB

- Thin Films Laboratory
- Molecular Beam epitaxy (MBE)

Preparation

- Low Temperatures and Magnetometry Lab
- Scanning Probe Microscopy (SPM/AFM)
- X-ray Diffraction Lab
- Electron Microscopy Service (TEM/SEM)
- Thermal Analysis Laboratory (ATG, DSC, BET)
- Spectroscopy (IR, UV, NMR, EPR)

Characterization

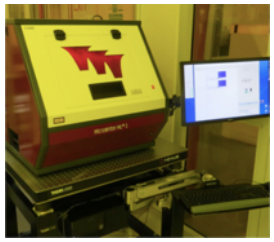
- Nanoquim Platform
- Soft Materials

Preparation and Characterization

http://icmab.es/research/scientific-technical-services

Nanoquim Platform

200m^2 of cleanroom area (Class 10000)
divided in five laboratories with independent regulation of humidity and temperature



- Optical Lithography

Micro-writer, facilities for photosensitive materials, Plasma cleaner

- Characterization of Functional Materials at the Nanoscale

Ellipsometry, Spectro-fluorometer, Optical Microscopes, Ultrasonic Wire Bounder, Profilometer

- Controlled growth of Nanomaterials

Atomic Layer Deposition System, Contact Angle, Rheometer, Reactive Ion etching, Metal evaporator, Ion milling/sputtering/e-beam system

- Chemical Synthesis

Chemical lab, spin coater, Glove box, microwave ovens, dip coater

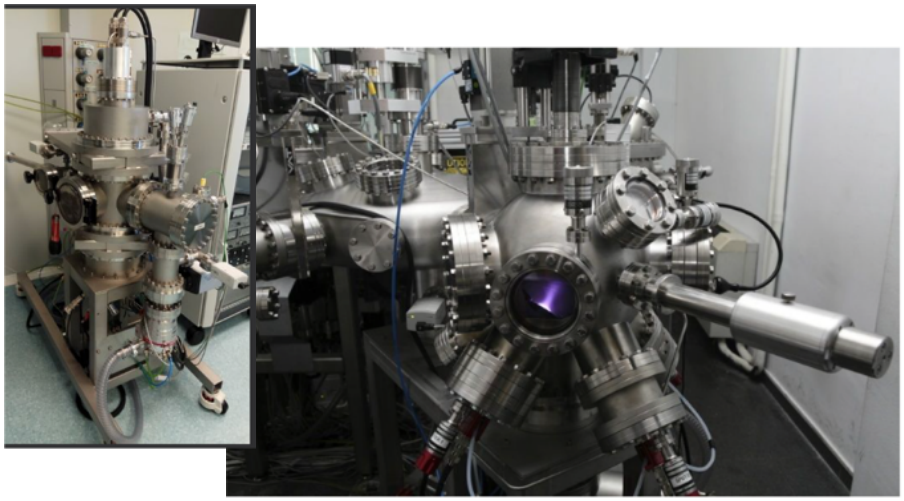
- Highly Controlled Humidity Lab.

In-jet printer, tubular furnaces, Rapid thermal annealing sister

(https://services.icmab.es/nanoquim/laboratories/)

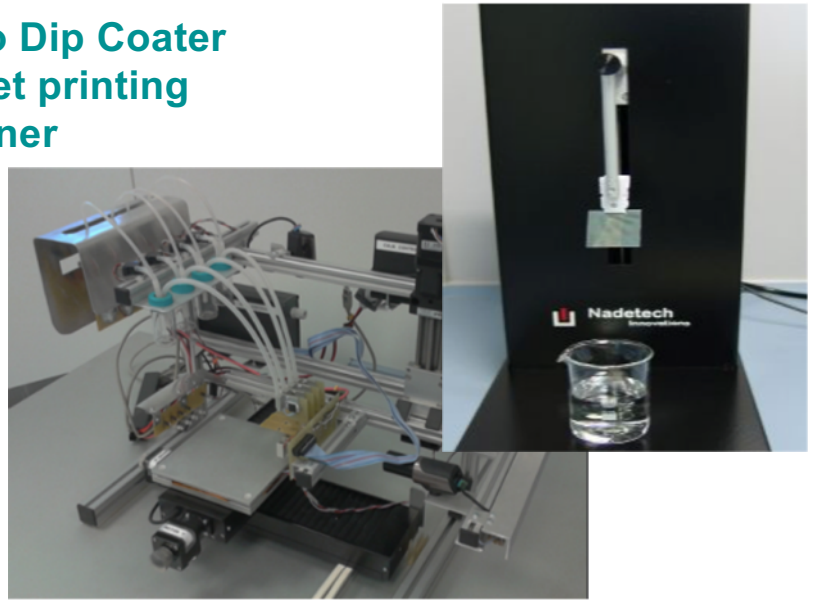
Thin Film Deposition

Ion Milling / Sputtering / E-Beam system
UHV cluster for PLD / Sputtering
Molecular Beam Epitaxy



Fabrication of complex oxides thin films and heterostructures combining oxides and metals

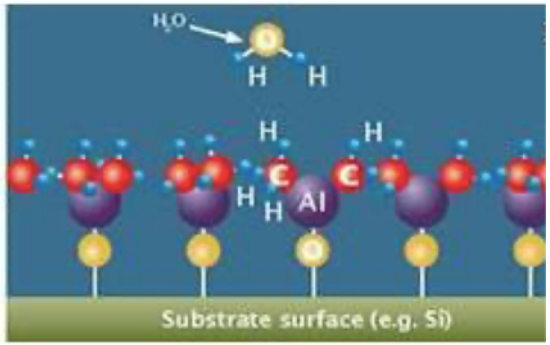
Nano Dip Coater
Ink-jet printing
Spinner



Fabrication of thin films by chemical deposition.

Atomic Layer Deposition (ALD)

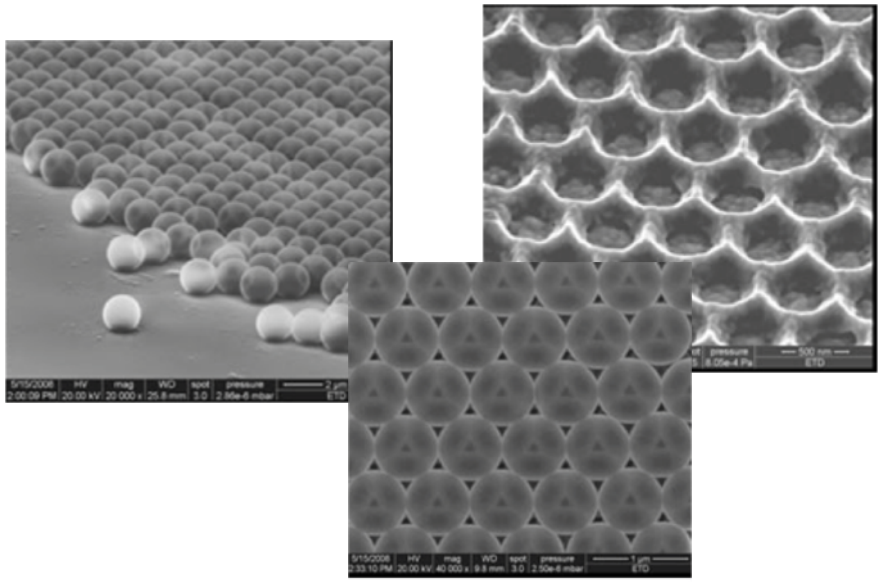
Precise control of depositions down to the atomic scale



Electron Microscopy Service

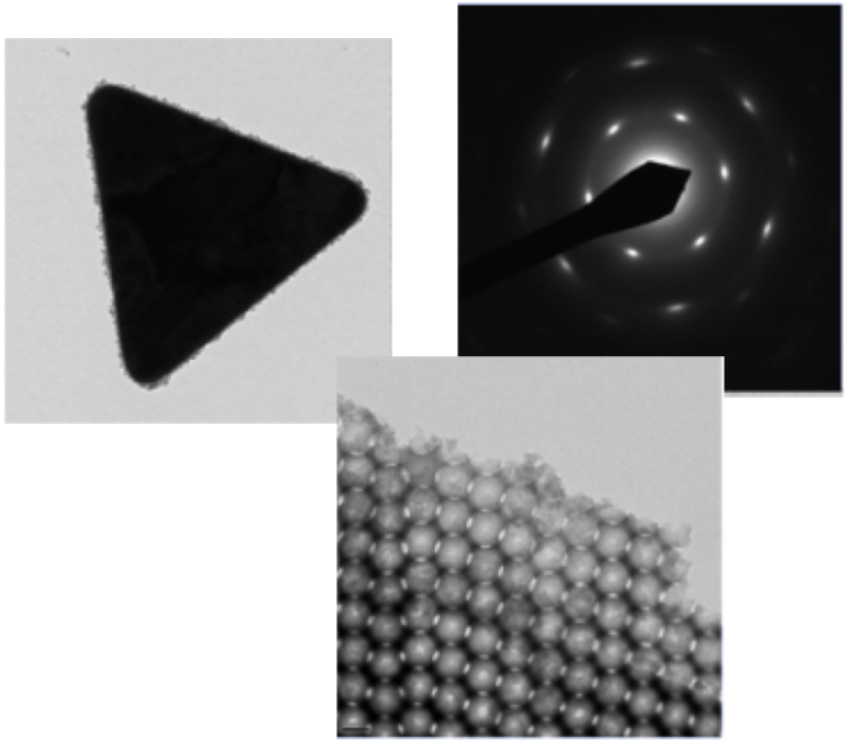
Scanning Electron Microscope (SEM) QUANTA FEI 200 Field emission gun (FEG)

- Electron Beam Lithography
- High vacuum low-vacuum and environmental SEM mode (ESEM).
- Energy Dispersive X-ray (EDX) system for chemical analysis.



Transmission electron microscope (TEM) 120 KV JEOL 1210

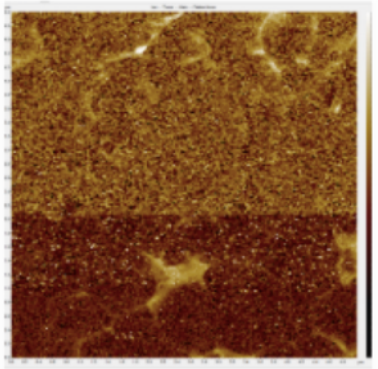
TEM features a high angular range (Tilt X= ± 60º, Tilt Y= ± 30º)



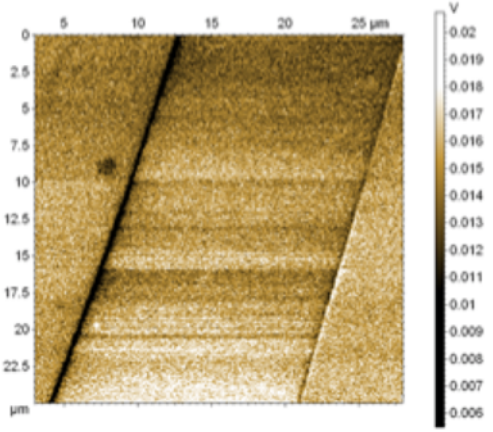
Scanning Probe Microscopy Laboratory

Characterization of functional materials at the nanoscale

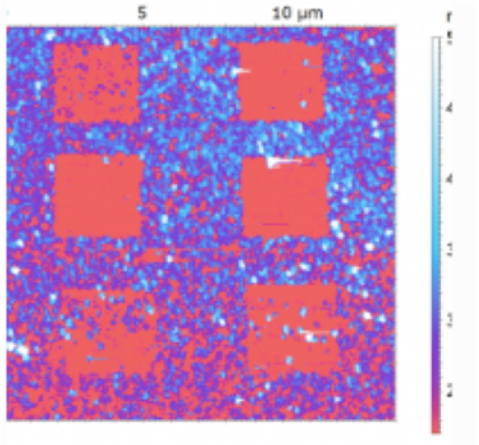
- Dynamic and Contact Atomic Force Microscopy
- Piezoresponse Force Microscopy
- Electrostatic Force Microscopy
- Kelvin Probe Force Microscopy
- Scanning Thermal Microscopy (from 2Q 2016)
- Photoconductive Atomic Force Microscopy
- Magnetic Force Microscopy



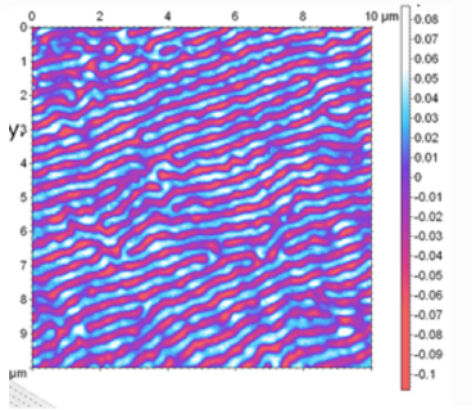
Photoconductive map of a solar cell



PFM amplitude of a polarized Ferroelectric material



C-AFM image of a patterned resistive-switching film

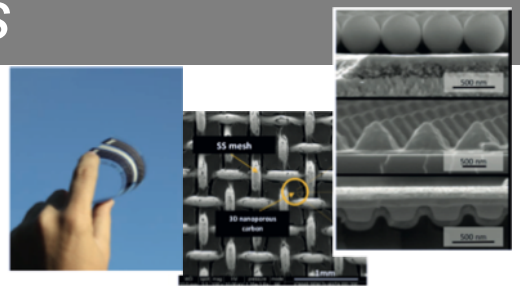


MFM domain pattern in a ferromagnetic material

ICMAB Research Lines

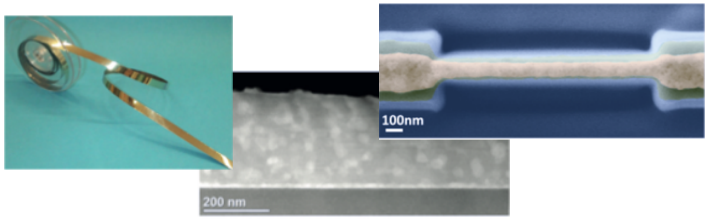
RL1: Sustainable Energy Conversion and Storage System

Energy materials to boost sustainability
Batteries, Thermoelectrics, Photovoltaics



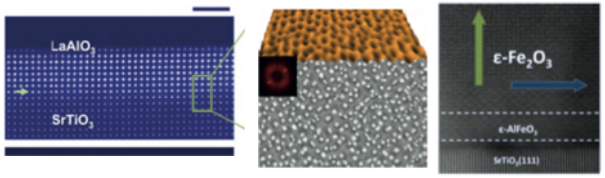
RL2: Superconducting Materials for Emerging Technologies

Superconducting materials for power applications and energy-efficient electronic devices



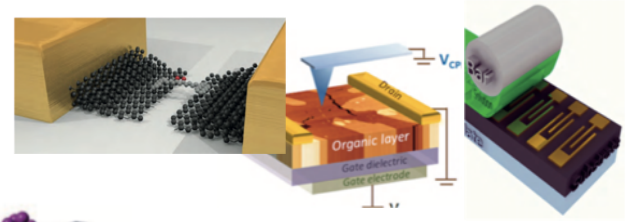
RL3: Oxides for New Generation Electronics

Transition metal oxides for efficient and energy friendly, storage, advanced computing and energy harvesting devices



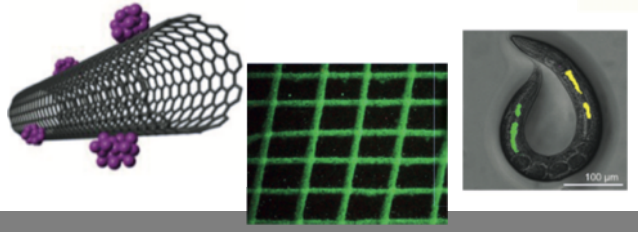
RL4: Tuneable and Low Cost Molecular Electronics

Molecular electronic devices
unimolecular electronics and spintronics, organic films, transistors and photovoltaics



RL5: Bioactive Materials for Therapy and Diagnosis

Smart multifunctional drug delivery systems, nano-objects for diagnosis and therapies, nanostructured materials for tissue repairing

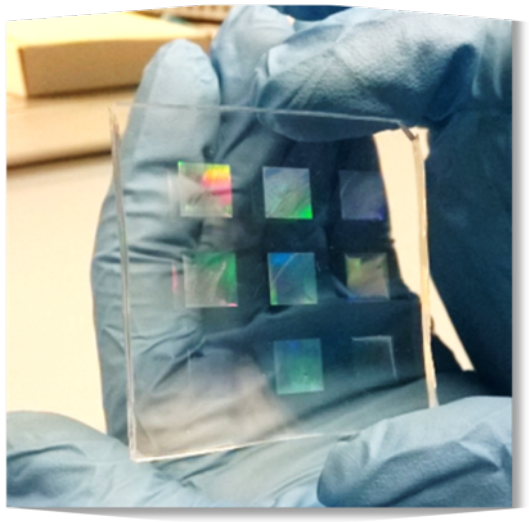


Photonic architectures created by soft nanoimprint lithography

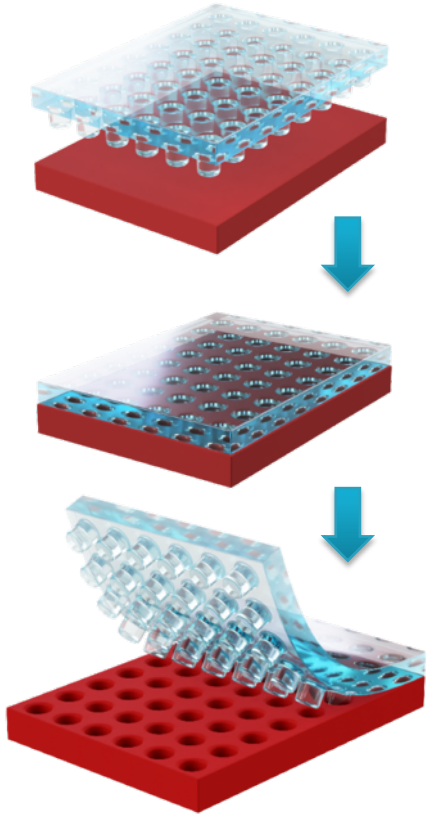
Soft Nanoimprint Lithography

Fabricate emerging optoelectronic devices with unconventional materials
Large area, low cost fabrication routes

The PDMS stamp



Printing process



The replica

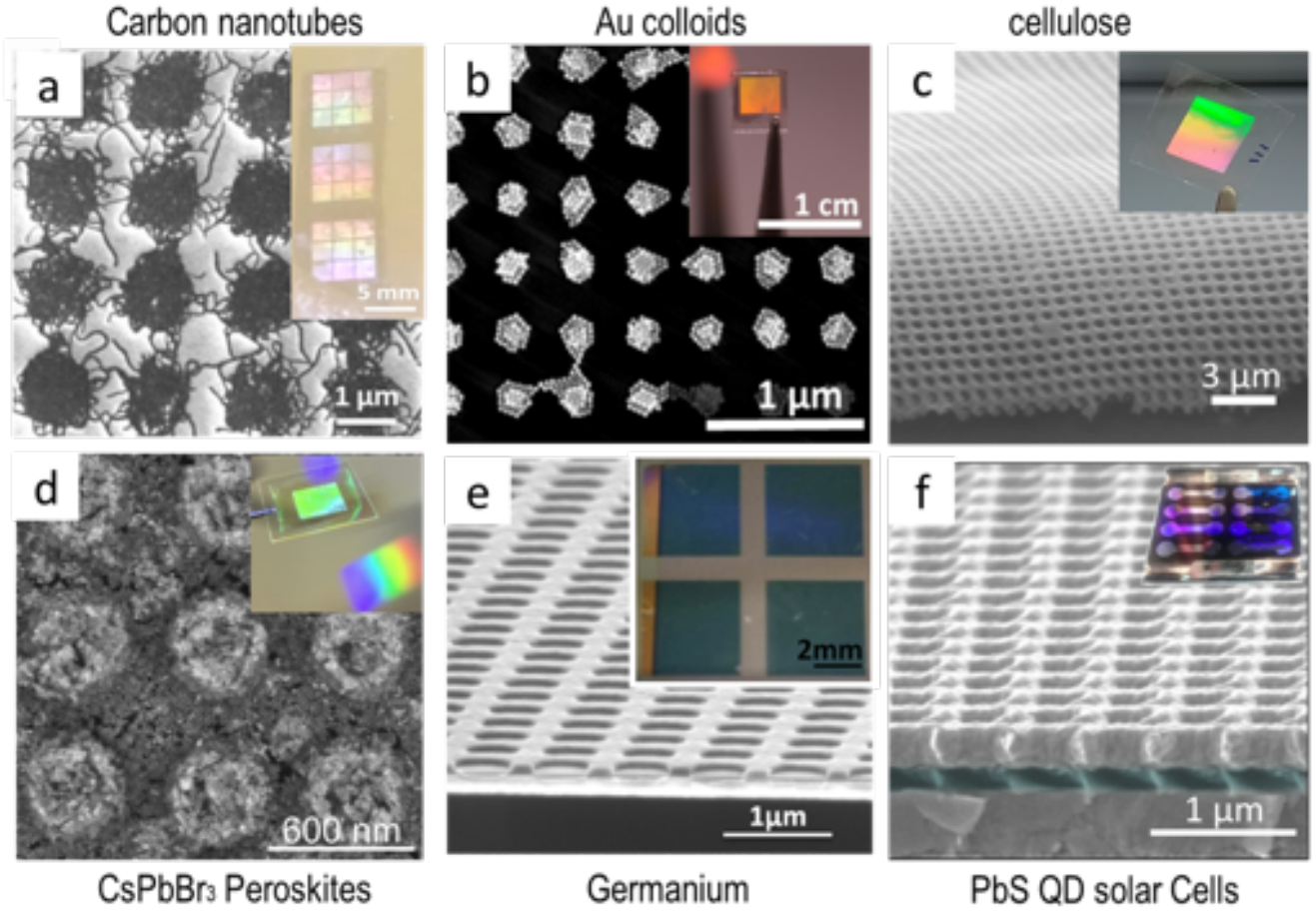
Apply:
- Pressure, Temperature
- UV light Solvents,..

ENLIGHTMENT erc European Research Council

https://enlightment.icmab.es/

Agustín Mihi *(amihi@icmab.es)*

Photonic architectures created by soft nanoimprint lithography



Photonic architectures exhibiting

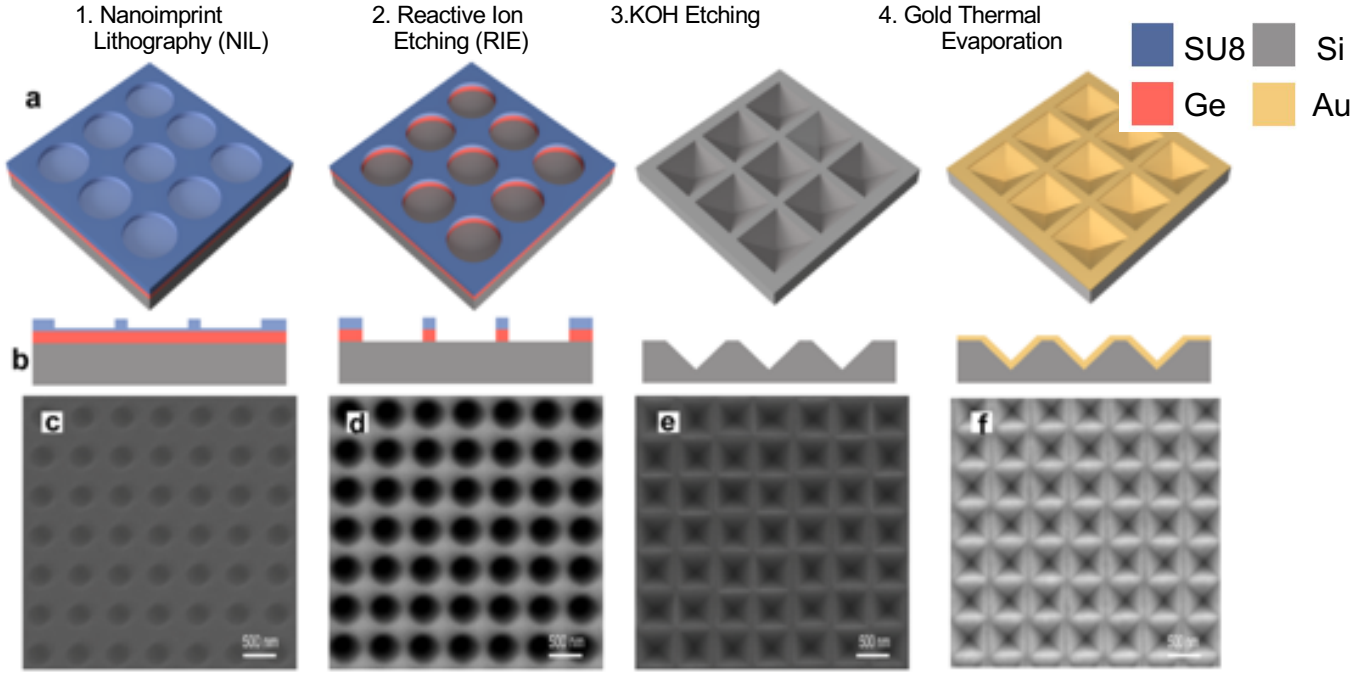
- properties inherited from the original materials (flexibility, biodegradability, biocompatibility)
- the complex optical response given by the nano-structuration.

a) Dore et al. ***Small*** *2020 In press, b) Matricardi et al.* ***ACS Nano*** *2019, c) Espinha et al.* ***Nature Photonics*** *2018,*
d) Vila-Liarte et al. ***Angew Chem****. 2020, e) Molet et al.* ***Adv. Mater.*** *2018, f) Kim & Molet et al.* ***Adv. Mater****. 2019*

Agustín Mihi *(amihi@icmab.es)*

Light harvesting nanostructures created by nanolithography

plasmonic structures for devices that generate hot electrons for IR light harvesting → transform sunlight into an electrical current via hot-electron generation



Nanolithography methodologies (NIL), combined with chemical and physical etching steps

→ different architectures like plasmonic inverted nano-pyramid arrays

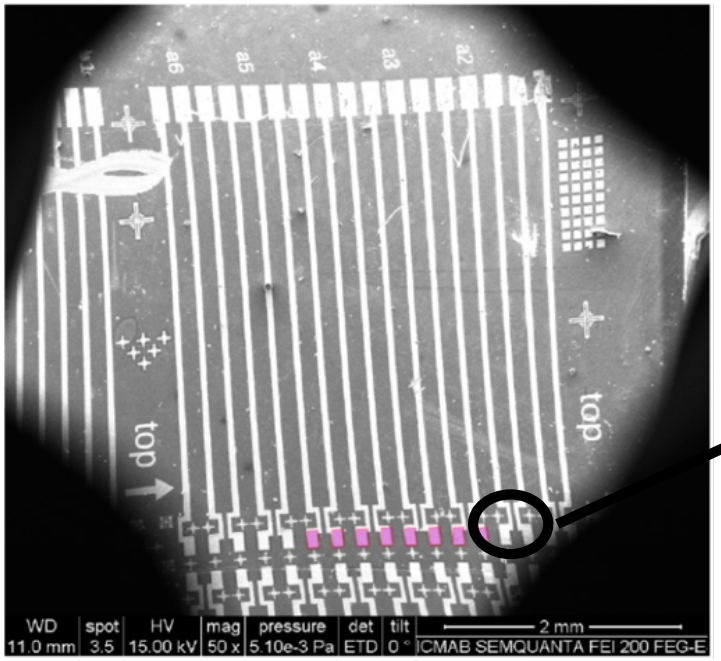
EU project: Plasmon-resonance driven thermionic emitters for improved solar energy harvesting
(PLASMIONICO)
A.R. Goñi (PI), L.A. Pérez, J. Hu, M.I Alonso.

Alejandro Goñi *(goni@icmab.es)*

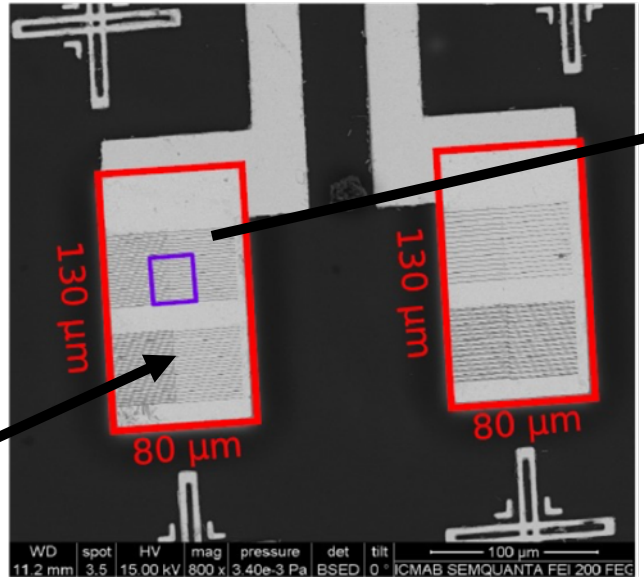
Photonic devices fabricated by EBL

One-dimensional photonic crystals, gratings and nanodisk arrays, with integrated ferroelectrics to build active photonic devices

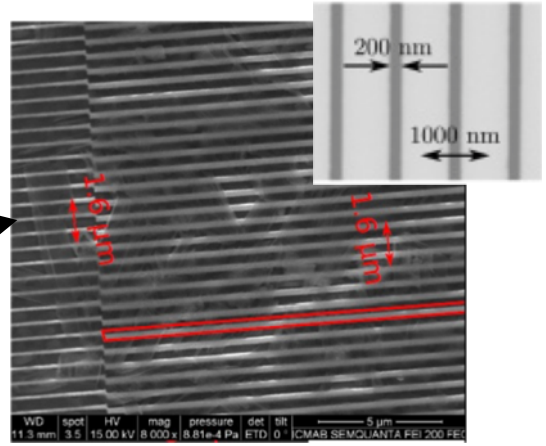
Magnetoplasmonic gratings



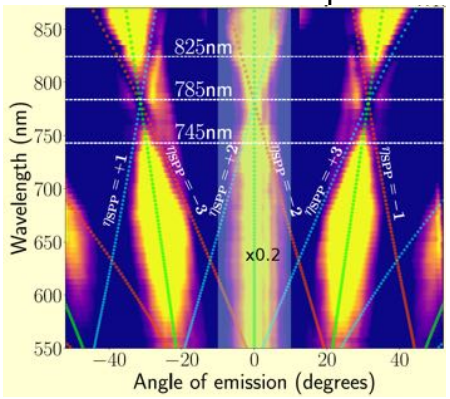
Multi-layer deposition + EBL + ion-milling



Au/Co/Au on top of $BaTiO_3$ structures



Angle-resolved reflectance spectrum



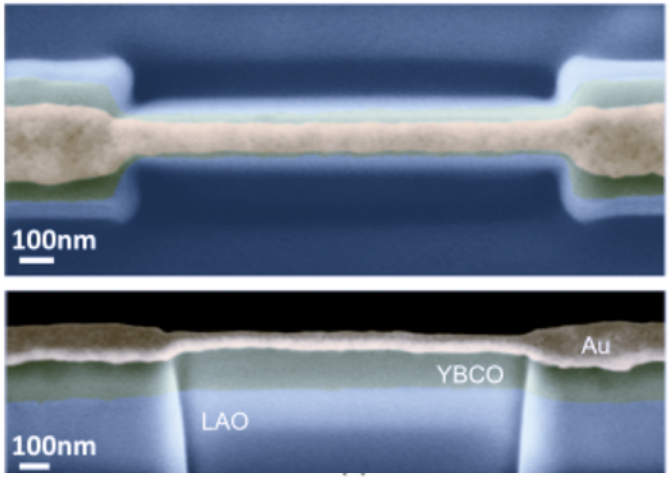
Gervasi Herranz, Rafael Cichelero, Mikko Kataja, Mariano Campoy-Quiles
Optics Express *26 34842-34852 (2018)*

Gervasi Herranz *(jherranz@icmab.es)*

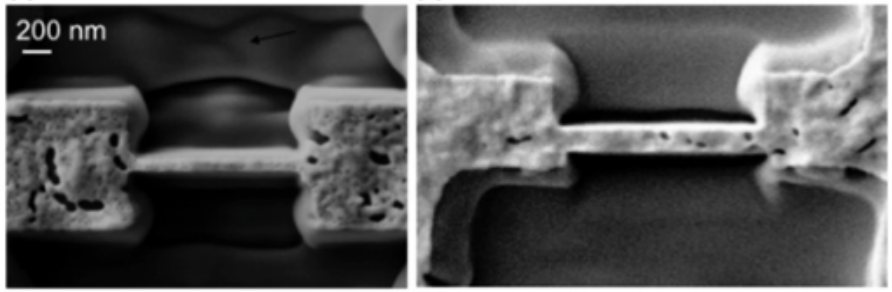
SC Nanowires and nanostructures fabricated by EBL & FIBL

Superconducting nanowires, symmetric and asymmetric nanostructures, with controlled vortex motion to build energy efficient fluxtronic devices

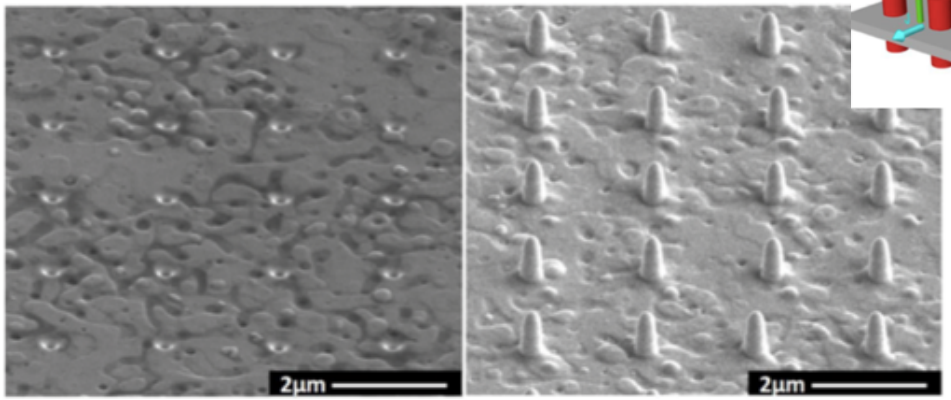
(a)

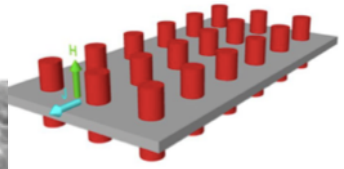


(b)



(c)

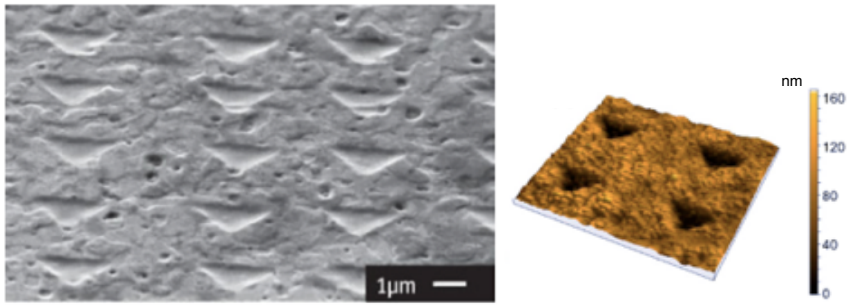




unizar

Collaboration J.M. De Teresa, R. Cordoba

(d)



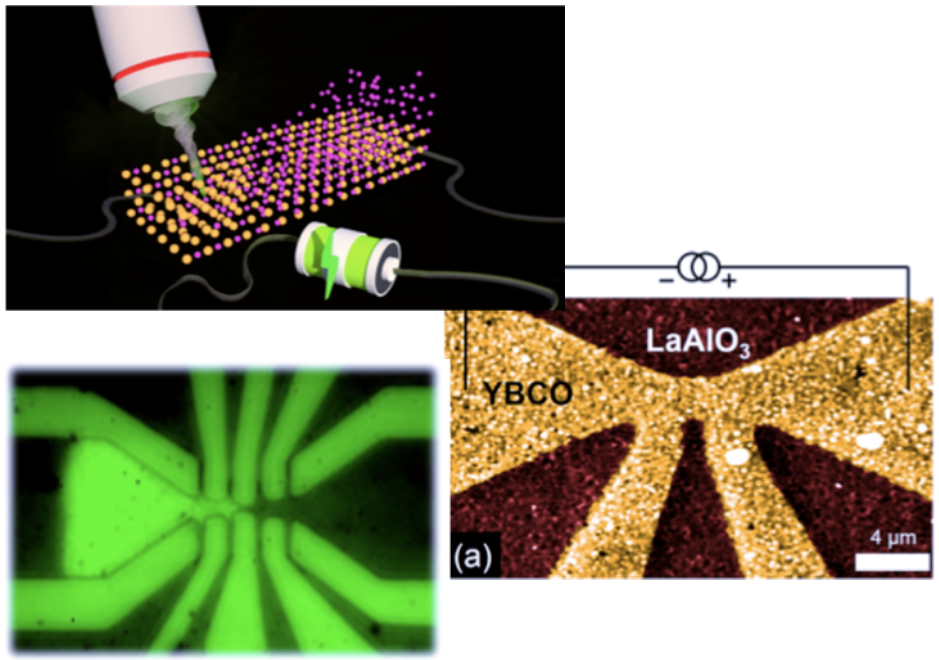
cnm

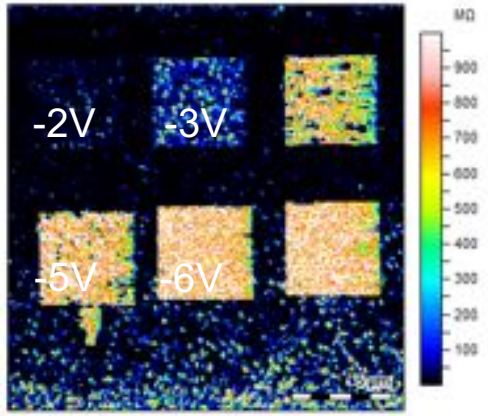
(a) Rouco et al. ***Nano Lett****, 19, 4174 (2019), (b) Rouco et al.* ***Materials*** *2018, 11, 211 (2018), (c) Rouco et al.* ***Sci. Rep.*** *7, 5663 (2017), (d) Palau et al. SC at the Nanoscale,* ***De Gruyter****, 195–220 (2017)*

Anna Palau *(palau@icmab.es)*

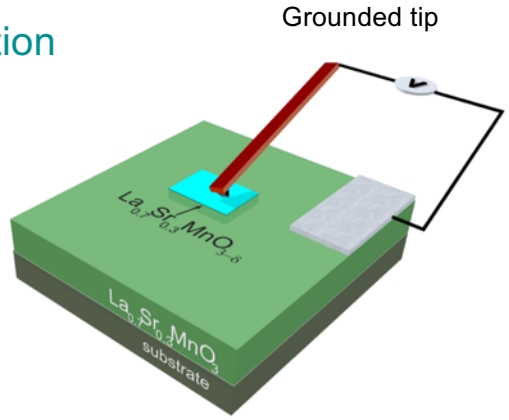
Nanoscale modulation of oxygen doping

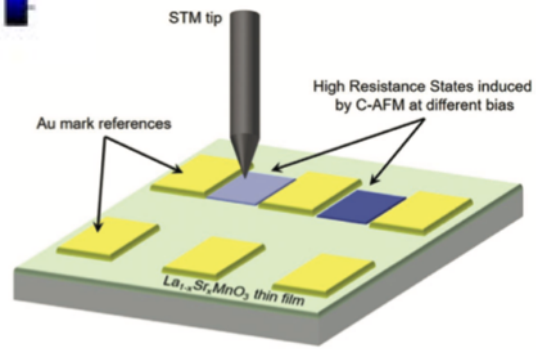
Nanoscale tuning of resistance through Voltage and Current-Stimulated Oxygen Migration





C-AFM Resistance map
1V reading voltage





Local Control of Metal–Insulator Transition for memory and neuromorphic applications

Marinkovic' et al. ***ACS Nano****, 14, 9, 11765 (2020), Gonazalez-Rosillo et al. Small, 2001307 (2020), Gonzalez-Rosillo et al.* ***Adv. Electron. Mater****. 1800629 (2019),*

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